IDENTIFICATION OF ACTION: Notice informing the public of EPA's intent to grant an exemption from the land disposal restrictions for two hazardous waste injection wells operated by Environmental Disposal Systems, Inc. in Romulus, Michigan.

Agency: Environmental Protection Agency (EPA)

Action: Notice of Intent to Grant an Exemption for the Injection of Certain Hazardous Wastes to Environmental Disposal Systems, Inc. for Two Injection Wells Located at 28470 Citrin Drive, Romulus, Michigan.

Summary: The United States Environmental Protection Agency, Region 5, Chicago office, proposes (through this notice) to grant an exemption from the ban on disposal of hazardous wastes through injection wells to Environmental Disposal Systems Inc. (EDS) of Birmingham, Michigan. If the exemption is granted, EDS may inject all Resource Conservation and Recovery Act (RCRA) regulated hazardous wastes with waste codes at 40 CFR Part 261 through waste disposal wells #1-12 and #2-12. The regulations promulgated under Section 3004 of RCRA, 42 U.S.C. § 6924, at 40 CFR Part 148 prohibit the injection of restricted hazardous waste into an injection well. Under 40 CFR §148.20, any person seeking an exemption from the prohibition must submit a petition demonstrating that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous.

On June 15, 1990, the Administrator delegated the authority to act on "no migration" petitions for deep injection wells to the Regional Administrator, who delegated the authority to the Director of the Water Division on February 23, 1996.

On January 21, 2000, EDS submitted a petition to the EPA, Region 5, Chicago office, seeking an exemption from the ban based on a showing under 40 CFR § 148.20(a)(1)(i) that any fluids injected will not migrate vertically out of the injection zone or laterally to a point of discharge or interface with an underground source of drinking water (USDW) within 10,000 years. The EPA has conducted a comprehensive review of the petition, its revisions, and other materials submitted and has determined that the petition submitted by EDS, as revised on October 3, 6, 27, and 31, 2000; January 12, April 24, and October 16, 2001; and January 31 August 22, September 25, and October 23, 2002, meets the requirements of 40 CFR Part 148 Subpart C.

Date: The EPA, Region 5, Chicago office, requests public comments on today's proposed decision. Comments will be accepted until January 17, 2003. Comments post-marked after the close of the comment period will be stamped **"Late"**. Late comments do not have standing and will not be considered in the decision process. EPA will schedule a public hearing to allow comment on this proposed action. EPA will publish a notice of this hearing in a local paper and send it to people on its mailing list. If you wish to be notified of the date and location of the public hearing please contact the person listed below. EPA will cancel the hearing if it has no evidence of a need for a hearing.

Addresses: Submit written comments, by mail, to:

Ms. Sally Swanson, Acting UIC Branch Chief
United States Environmental Protection Agency, Region 5,
Underground Injection Control Branch (WU-16J)
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

or, to use e-mail, direct comments to swanson.sally@epa.gov.

For Further Information Contact: Mr. Harlan Gerrish, Lead Petition Reviewer, at the same address, Office Telephone Number: (312) 886-2939, or, to use e-mail, direct comments to gerrish.harlan@epa.gov.

Supplementary Information:

I. Background

A. Authority - The Hazardous and Solid Waste Amendments (HSWA) to the RCRA were enacted on November 8, 1984, and impose substantial additional responsibilities on those who handle hazardous waste. The amendments prohibit the land disposal of untreated hazardous waste beyond specified dates, unless the EPA determines that the prohibition is not required in order to protect human health and the environment for as long as the waste remains hazardous (RCRA Section 3004(d)(1), (e)(1), (f)(2), (g)(5)). RCRA specifically defines land disposal to include any placement of hazardous waste into an injection well (RCRA Section 3004(k)). After the effective date of prohibition, hazardous waste can only be injected under two circumstances:

1) When the waste has been treated in accordance with the requirements of 40 CFR Part 268 as required by Section 3004(m) of RCRA, (the EPA has adopted the same treatment standards for injected wastes in 40 CFR Part 148, Subpart B); or

2) When the owner/operator has demonstrated that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. Applicants seeking an exemption from the ban must demonstrate that the hydrogeological and geochemical conditions at the site and the physicochemical nature of the waste stream(s) are such that reliable predictions can be made either:

   a) that fluid movement conditions are such that the injected fluids will not migrate within 10,000 years: 1) vertically upward out of the injection zone; or 2) laterally within the injection zone to a point of discharge or interface with an Underground Source of Drinking Water (USDW) (the no-migration standard); or
   b) that before the injected fluids migrate out of the injection zone or to a point of discharge or interface with USDW, the fluid will no longer be hazardous because of attenuation, transformation or immobilization of hazardous constituents within the injection zone by hydrolysis, chemical interactions or other means.

EDS has submitted a petition that uses mathematical models to demonstrate that the injected fluids will not migrate within 10,000 years.

The EPA published regulations setting forth the requirements for petitions for exemption from the disposal prohibition in the Federal Register on July 26, 1988 (53 FR 28118). The demonstrations are based on direct measurements of geological properties of the injection zone made during the construction and subsequent testing of the wells at the EDS facility on Citrin Drive or on values measured at similar locations where conditions can be expected to be near equivalents. Because the model encompasses a region which is much larger than sampling techniques employed along and between the well bores can reach, the demonstration allows for uncertainty by using values which are more conservative than those which the petitioner believes are most appropriate. The measurements are used to create a conceptual model of the geological framework into which waste is injected. Models must account for such geological properties as the porosity, permeability, and compressibility of the strata within the injection zone which will serve as the reservoir and the strata which are expected to confine the waste within the injection zone. Characteristics, such as density and viscosity, of the brine currently within the injection zone and of the waste which will be injected are also considered. Equations have been developed to calculate the pattern and extent of pressure increase resulting from injection for many different geologic models. When the proposed injection is simulated, computer programs use the appropriate equations to calculate the amount and distribution of increased pressure in the disposal reservoir. The distance which fluid and then independent molecules of the injected waste will move through the reservoir and confining zone are also calculated.

During the period of injection, fluids are pumped through the injection wells into porous geological formations at pressures which are sufficient to force the fluids to flow thousands of feet into the formations. In most cases, the operator of a particular group of injection wells controls the only injection occurring in the area. If there are other nearby injection or production wells, however, they will also affect how fluids move. Injection moves the fluids at a relatively high velocity. This movement slows immediately, but continues at greatly reduced speed for a time after injection ends. The length of that time is approximately equal to the length of the injection phase. By the end of that time, the continued movement has allowed the hydraulic pressures around the injection wells to return to the pre-injection level, if it is a large injection formation. After the pressure dissipates, significant movement of waste fluid results from three phenomena: natural background or regional flow, density differences, and diffusion of individual molecules through geological materials.

The simulation of waste movement is carried forward for a period of 10,000 years. EPA chose a time limit of 10,000 years for the demonstration because a demonstration over that time period would both suggest containment for a substantially longer time period and a 10,000-year time frame would allow time for geochemical transformations which might render the waste nonhazardous or immobile. (*See* 53 FR 28126). The EPA's Science Advisory Board agreed that the 10,000 year time frame is appropriate in a 1984 study dealing with the storage of radioactive wastes. The EPA's standard does not imply that leakage will occur at some time after 10,000 years. It requires a demonstration that leakage will not occur within that time frame. Understanding geological factors such as the permeability of intact rock, the presence of transmissive fractures, and the identification of artificial penetrations of the confining zone provides the key to constructing an accurate model and performing a valid simulation. Because 10,000 years is a relatively short interval of geologic time, we assume that only the three phenomena listed above affect the rate of movement. Each of these phenomena is well understood, and their effects can be calculated. If the simulation establishes that the injected waste will not escape a defined volume of rock which is some distance below the USDWs or discharge to a USDW for a period of 10,000 years, the operation meets the regulatory no migration standard.

B. **<u>Facility Operation</u>** - EPA previously issued permits to the proposed EDS facility to commercially dispose of liquid wastes by deep well injection. The operator has constructed two wells. The proposed exemption is based on a long term average injection rate, for the facility as a whole, of 166 gallons per minute (gpm) averaged over one-month periods for a total of 7,275,780 gallons per month. The instantaneous injection rate may reach 270 gpm for the facility. The long term average rate limit is used to bound the area of the waste plume so that the plume will be no larger than the area estimated in the petition. The instantaneous limit will allow EDS to inject more waste for some periods of time than others to accommodate deliveries during normal business hours and other occurrences. The rate at which EDS may inject is also limited by the maximum allowable surface injection pressure.

The conservative nature of the demonstration is a significant aspect of the demonstrations. The result of the simulations which comprise the demonstration are not predictions of the distance to which the hazardous waste plume will move. Rather, they are predictions of a distance beyond which movement will not occur. That is, the actual distance of movement is expected to be considerably less than that simulated.

C. **Submission** - On January 21, 2000, EDS submitted a petition for exemption from the land disposal restrictions of hazardous waste injection under the HSWA of RCRA. EPA reviewed this submission for completeness and provided comments. EPA received revised documents on October 3, 6, 27, and 31, 2000; January 12, April 24, and October 16, 2001; and January 31, August 22, September 25, 2002 and October

23, 2002, responding to EPA comments.

II. <u>Basis for Determination</u>

A. <u>Waste Description and Analysis (40 CFR §148.22)</u> - Under the proposed exemption, EDS can inject wastes from a variety of industrial sectors and processes including: pharmaceutical production, steel pickling operations, automobile parts fabrication, and other commercial disposal operations at facilities which do not have the means to dispose of hazardous liquid wastes. EDS has petitioned the EPA, Region 5, to grant an exemption to allow injection of wastes bearing the following RCRA waste codes:

List of RCRA Waste Codes Approved for Injection:

D001	D025	F006	K002	K027	K051	K103	K141	K177	P024	P051	P081	P111	P199
D002	D026	F007	K003	K028	K052	K104	K142	K178	P026	P054	P082	P112	P201
D003	D027	F008	K004	K029	K060	K105	K143	P001	P027	P056	P084	P113	P202
D004	D028	F009	K005	K030	K061	K106	K144	P002	P028	P057	P085	P114	P203
D005	D029	F010	K006	K031	K062	K107	K145	P003	P029	P058	P087	P115	P204
D006	D030	F011	K007	K032	K069	K108	K147	P004	P030	P059	P088	P116	P205
D007	D031	F012	K008	K033	K071	K109	K148	P005	P031	P060	P089	P118	U001
D008	D032	F019	K009	K034	K073	K110	K149	P006	P033	P062	P092	P119	U002
D009	D033	F020	K010	K035	K083	K111	K150	P007	P034	P063	P093	P120	U003
D010	D034	F021	K011	K036	K084	K112	K151	P008	P036	P064	P094	P121	U004
D011	D035	F022	K013	K037	K085	K113	K156	P009	P037	P065	P095	P122	U005
D012	D036	F023	K014	K038	K086	K114	K157	P010	P038	P066	P096	P123	U006
D013	D037	F024	K015	K039	K087	K115	K158	P011	P039	P067	P097	P127	U007
D014	D038	F025	K016	K040	K088	K116	K159	P012	P040	P068	P098	P128	U008
D015	D039	F026	K017	K041	K093	K117	K160	P013	P041	P069	P099	P185	U009
D016	D040	F027	K018	K042	K094	K118	K161	P014	P042	P070	P101	P188	U010
D017	D041	F028	K019	K043	K095	K123	K169	P015	P043	P071	P102	P189	U011
D018	D042	F032	K020	K044	K096	K124	K170	P016	P044	P072	P103	P190	U012
D019	D043	F034	K021	K045	K097	K125	K171	P017	P045	P073	P104	P191	U014
D020	F001	F035	K022	K046	K098	K126	K172	P018	P046	P074	P105	P192	U015
D021	F002	F037	K023	K047	K099	K131	K173	P020	P047	P075	P106	P194	U016
D022	F003	F038	K024	K048	K100	K132	K174	P021	P048	P076	P108	P196	U017
D023	F004	F039	K025	K049	K101	K136	K175	P022	P049	P077	P109	P197	U018
D024	F005	K001	K026	K050	K102	K140	K176	P023	P050	P078	P110	P198	U019

U020	U068	U115	U160	U209	U375
U021	U069	U116	U161	U210	U376
U022	U070	U117	U162	U211	U377
U023	U071	U118	U163	U213	U378
U024	U072	U119	U164	U214	U379
U025	U073	U120	U165	U215	U381
U026	U074	U121	U166	U216	U382
U027	U075	U122	U167	U217	U383
U028	U076	U123	U168	U218	U384
U029	U077	U124	U169	U219	U385
U030	U078	U125	U170	U220	U386
U031	U079	U126	U171	U221	U387
U032	U080	U127	U172	U222	U389
U033	U081	U128	U173	U223	U390
U034	U082	U129	U174	U225	U391
U035	U083	U130	U176	U226	U392
U036	U084	U131	U177	U227	U393
U037	U085	U132	U178	U228	U394
U038	U086	U133	U179	U234	U395
U039	U087	U134	U180	U235	U396
U041	U088	U135	U181	U236	U400
U042	U089	U136	U182	U237	U401
U043	U090	U137	U183	U238	U402
U044	U091	U138	U184	U239	U403
U045	U092	U139	U185	U240	U404
U046	U093	U140	U186	U243	U407
U047	U094	U141	U187	U244	U408
U048	U095	U142	U188	U246	U409
U049	U096	U143	U189	U247	U410
U050	U097	U144	U190	U248	U411
U051	U098	U145	U191	U249	
U052	U099	U146	U192	U271	
U053	U101	U147	U193	U277	
U055	U102	U148	U194	U278	
U056	U103	U149	U196	U279	
U057	U105	U150	U197	U280	
U058	U106	U151	U200	U328	
U059	U107	U152	U201	U353	
U060	U108	U153	U202	U359	
U061	U109	U154	U203	U364	
U062	U110	U155	U204	U365	
U063	U111	U156	U205	U366	
U064	U112	U157	U206	U367	
U066	U113	U158	U207	U372	
U067	U114	U159	U208	U373	

B. **<u>Well Construction and Operation (148.22)</u>** - EDS plans to operate the disposal wells for at least 20 years. The physics of well injection is well understood because of theoretical studies conducted by oil production companies and observations through the long history of injection and production in oil fields. EPA has developed the UIC program under the Safe Drinking Water Act to prevent underground injection which endangers USDWs. The program regulates construction and operation of most injection wells. The regulations impose extra requirements on hazardous waste injection wells. The operations of wells used for the disposal of hazardous wastes are subject to an exacting permitting program, monthly review of monitoring records, and periodic testing of the well and disposal reservoir. Additional safeguards, such as those set forth in the proposed decision, are also imposed.

Figure 1 includes a schematic diagram of the construction of Well #2-12 and the formations penetrated by the wells. The EDS wells have been constructed using four strings of steel casing for each well. As the wells were drilled, increasingly smaller casings were placed in the well and cemented to the surface. The first cemented casings are 20 (in #1-12) and 16 (in #2-12) inches in diameter and were set at 119 and 177 feet, respectively, to stabilize the well bores through the unconsolidated glacial drift. The second strings of casing are 13-3/8 inches in diameter and were set at 396 and 598 feet, respectively, to prevent loss of drilling fluid into cavernous zones in the shallow bedrock. The third strings of casing were planned to provide the safest possible conduit through the near-surface USDWs. These casings are 9-5/8 inches in diameter and are set at 824 and 1444 feet, respectively. The final casing is set from the surface to within the top of the formations which will be used as the waste reservoir. These casings are 7 inches in diameter and are set at 4,080 and 3,983 feet, respectively. The space around each of the casings was sealed with cement from the base of the casing to the surface. Cementing eliminates potential avenues for either the injected fluid or fluid from other, shallower zones to flow outside the casings and into USDWs.

EDS will inject the waste through a tubing set on a packer and isolated from the casing by a fluid-filled annulus, which will be continuously monitored for pressure change. The monitoring system is designed to trigger alarms and shut off injection if the injection pressure exceeds the maximum permitted levels, or if the difference between the injection and annulus pressures falls below the minimum permitted level.

Thus, the integrity of the construction will be monitored constantly by measuring the pressure within the annulus between the casings and tubing and tracking the amounts of liquid added to or removed from the annulus system. Even a small leak should be detected before environmental injury occurs. More rigorous annual testing ensures that even very small leaks are discovered. The pressure in the annulus will be maintained at a higher level than the pressures in either the formations outside the casing or within the injection tubing. Therefore, even if a leak occurs, the waste will not leak into the annulus; instead, annulus fluid will leak into the injection tubing through which waste is being injected and be carried downward into the waste disposal reservoir or, in the case of a casing leak, annulus fluid, not waste, will leak into the formations surrounding the well.

As described, the construction provides for a replaceable tubing and a system to detect when replacement of the tubing is necessary. The tubing prevents the waste from contacting all except the lowermost few tens of feet of casing, which are made of a corrosion resistant alloy. The three casing strings and layers of cement through the fresh water bearing formations provide extra protection from contamination.

In order to ensure that the wastes, once safely injected into the disposal formation, remain there, the UIC program regulates injection pressure and waste properties, and requires regular testing of the integrity of injection wells' construction. The injection pressure is important because injection pressure drives fluid movement through both the reservoir rock and the overlying confining rock. No rock is completely impermeable. Because the confining rock is usually less than one thousandth as permeable as reservoir rock, the distance of vertical movement through the confining rock is less than one thousandth as great as the horizontal movement through the reservoir rock. If sufficiently high, the injection pressure will fracture the reservoir rock and, at higher pressures, may fracture the confining rock. Therefore, EDS conducted tests during well construction to measure the resistance of the rock of the injection and confining zones to fracturing. These tests showed that injecting at pressures below 903 pound per square inch (psi) measured at the surface will not create fractures in the injection zone. The permits are being modified to limit the injection pressure at the surface to 903 psi.

The permits for the injection wells will limit the rate of injection, the pressure at which injection takes place, and the concentration of hazardous constituents to ensure that the actual conditions under which injection occurs are less likely to cause increased migration of hazardous constituents than those proposed and simulated as described in section F of this Fact Sheet. This will ensure that injected wastes will remain in the disposal formations, at depths below 3,700 feet, for at least 10,000 years.

Information available includes results of testing a well which EDS drilled in 1993, four miles away from the locations of wells #1-12 and #2-12. This well is the nearest well drilled into the Mt. Simon, Eau Claire, and lower Franconia Formations, which will serve as reservoirs; or into the upper Franconia-Dresbach, Trempealeau, Greenwood, and lower Black River Formations, which will serve as the arresting interval for wastes injected by EDS. Information from this well and other wells in Michigan and Ohio was used to determine the extent and shape of the important geological formations. Other nearby wells tend to go no deeper than the Trenton Formation which was penetrated at about 2,950 feet in the EDS wells.

Additional information was gained through testing of the new wells. Among other information, the UICB reviewers looked at the distribution of porosity and permeability along the well bore, the hydrostatic pressure in the reservoirs to be used for disposal, and the fracture opening and closure pressures in the disposal formation as well as in the overlying formations. The interaction of these factors determines the rate at which waste can be injected without having effects on the injection zone that can result in vertical movement through created fractures. The cementing and condition of the casing were also reviewed and found adequate.

C. **<u>Mechanical Integrity Test Information</u>** - The mechanical integrity tests described below were witnessed by EPA's contract inspectors. The test records were examined by UICB employees who recorded their observations and concluded that the tests were successfully passed.

To assure that the waste does not leak from the tubing prior to reaching the injection zone, 40 CFR §148.20(a)(2)(iv) requires submission of results from a satisfactory annulus pressure test and a Radioactive Tracer Survey to test the cement seal at the base of the casing which were performed within one year of petition submission. On April 4, 2002, EDS used a pressure test to demonstrate the absence of leaks in the casing, tubing and packer of well #1-12 by forcing water into the annulus to create a pressure of 1,130 psi and then closed the valve used to add water to the annulus. The test standard is a pressure change of less than 3% in one hour. The pressure declined by 11 psi, which is just less than 1%. On April 4, 2002, EDS tested the construction of well #2-12 by using 1,110 psi. The pressure declined to 1,090 psi. Twenty psi is about 2%, so both wells passed the test and demonstrated the absence of leaks in the tubing and casing, and packers. This aspect of mechanical integrity (MI) is discussed in the federal regulations at 40 CFR §146.8(a)(1). The sealing of the casing to the rock surrounding the well bore immediately above the injection interval was tested using a short-lived radioactive (RA) tracer material which was carried deep into each well by a geophysical logging tool lowered into the wells on a cable on January 8, 2002, in the case of well #1-12, and on December 6, 2001, in the case of well #2-12. The tracer was released during injection of fresh water. The same tool which releases the tracer also contains detectors that are used to trace the movement of the RA tracer. If the cement sealing the well bore is not sound, RA material will go up the well bore outside the casing. The logging tool is used to determine the depth to which the tracer moves before it leaves the well bore. There was no indication of upward movement during either test. Both of these tests will be repeated annually.

In addition, EDS made temperature measurements at short intervals along the well bores to determine if liquid is moving from any formations penetrated by the well, along the well bore, and into a USDW. New temperature logs will be made at five-year intervals. These two tests (radioactive tracer surveys and temperature logs) offer very effective means of determining whether the injected waste remains in the injection zone.

D. **<u>Site Description</u>** - The EDS injection wells are located at 28470 Citrin Drive within the City of Romulus in Wayne County, Michigan, near Detroit.

1. <u>Geological Location</u> – Geologically these wells are located on the eastern edge of the Michigan Basin. Locally, dip is to the northwest at about 100 feet per mile. About 4,350 feet of Paleozoic sedimentary rocks covered by about 100 feet of glacially deposited materials overlie the granitic Precambrian basement.

The injection wells at the EDS facility have approximately 2,980 feet of separation between the lowermost USDW, found in the Detroit River Formation, less than 390 feet below the surface, and the top of the injection zone 3,369 feet below the surface (*See* Figure 1). This separation zone is composed of dolomites, shales, sandstones and siltstones which are predominantly characterized by low permeability at this location. Pressure bleed-off zones are an important factor in the containment of wastes. All sedimentary formations are made up of horizontal layers which have differing permeabilities. Layers with low permeability retard upward movement and layers with high permeability allow both upward and horizontal movement. Because upward movement is resisted again and again by layers with low permeability, fluids tend to flow horizontally. As a result, the pressure which drives the movement is reduced by the horizontal flow which occurs in any layer having higher permeability than the layer above it. The regulations require at least one major permeable bleed-off zone between the injection zone and the base of the USDWs. At the EDS facility, the major bleed-off zones are the White Niagaran between 2,133 and 2,227 feet and the Sylvania Sandstone between 400 and 550 feet below the surface. In addition, numerous other zones are composed of sand or dolomitized limestone which have sufficient porosity and permeability to function as pressure bleed-off zones.

<u>Seismicity</u>. Michigan is an area of low seismic risk. Earthquakes felt in Michigan have been generally minor. Moreover, the steel casings of deep injection and production wells are more flexible and resilient than the rock through which they pass. As a result, they are not damaged as a result of earthquakes unless actually

sheared as a result of movement along a fault which they penetrate as demonstrated by wells in seismically active areas like California and Alaska. Because the Midwestern earthquakes are widely scattered, with none reported in the immediate vicinity of the EDS location, and have epicenters deep within the Precambrian granitic rocks far below the injection reservoir, there is virtually no possibility of damage as a result of seismic activity.

2. Injection Zone Description - The injection zone must have reservoir strata with sufficient permeability, porosity, thickness, and areal extent to allow the injected fluid to be distributed through a large volume of rock so that there is no long term increase in pressure in the injection zone. Above the reservoir zone, the injection zone must have strata which have low vertical permeability and are continuous across the area within which the reservoir strata will be affected by injection. These are called arresting strata, and they prevent upward movement of wastes from the injection zone to USDWs or the surface.

The injection zone for the EDS facility is between 3,369 and 4,468 feet below the surface. It consists of 900 feet of reservoir and overlying arresting strata, and includes upper Precambrian rocks at the base and the Mt.Simon, Eau Claire, Franconia-Dresbach, Trempealeau, Glenwood, and lower Black River Formations (*See* Figure 1). EDS has subdivided the injection zone into an injection interval and an arrestment interval. The Mt. Simon, Eau Claire, and Franconia-Dresbach Formations at depths from 3,937 to 4,550 feet below the surface will actually contain the injected wastes. They make up the injection interval. The Trempealeau, Glenwood and Black River Formations between 3,369 and 3,937 feet below the surface will prevent the waste from moving upward. They make up the arrestment interval. Each of these formations extends far beyond the vicinity of the EDS facility. The Mt. Simon and Eau Claire Formations reach the surface in Wisconsin, hundreds of miles from the EDS facility.

Waste is injected directly into the injection interval from the open-hole portion of the waste disposal wells. The Mt. Simon and Eau Claire Formations are composed of sandstones interbedded with siltstone, limestone, dolomite, and shale. These formations contain a number of zones which appear capable of accepting injected waste. The lower limit for porosity of rock which seems to accept injected liquids is 12%. The open-hole geophysical logs identified a total of 255 feet of section with porosity greater than 12%.

The permeability for the receptive intervals of the Eau Claire and Mt. Simon as a whole has been calculated by analyzing the pressure changes occurring during injection tests. A two-layer model was required in order to simulate the pressures actually recorded. The two layers are actually a summation of the effects of numerous layers, some with higher permeability and some with lower. The zones with higher permeability can be described as 33 feet in thickness with an average permeability of 400 millidarcies (md). The zone with lower permeability can be described as 190 feet thick with an average permeability of 63.43 md.

The arresting interval is the portion of the injection zone above the injection interval, and contains dense carbonates and shale units with low permeability and porous carbonates and sandstones which are pressure bleed-off units. EDS calculated an average permeability for the arresting interval by calculating the harmonic average of vertical permeability measurements from the core samples having less than 12% porosity. That analysis concluded that the effective vertical permeability of the arresting interval is less than 0.005 md.

Fracture logging of the three wells drilled by EDS indicated several sub-vertical fractures in the arresting interval. These fractures have limited height and appear to be filled by mineral deposits, and do not compromise the integrity of the arresting interval. Because there are no known transmissive fractures or faults in the arresting interval, it is suitable for long term waste retention.

3. <u>Confining Zone Description</u> - In addition to the arresting strata within the injection zone, the injection zone must be overlain by a second series of strata which are sufficient to prevent upward fluid movement. These strata are known as the confining zone. Like the arresting interval, the confining zone must be (1) laterally continuous, (2) free of transecting, transmissive faults or fractures over an area sufficient to prevent fluid movement, and (3) of sufficient thickness and lithologic and stress characteristics to prevent vertical propagation of fractures. The immediate confining zone above the injection zone at EDS is made up of the upper Black River Limestone, the Trenton Formation, and the Utica and Cincinnatian Shales which are found between 2,364 and 3,369 feet (*See* Figure 1). This confining zone is 1,000 feet in thickness, and the top is at an elevation 2,000 feet below the lowermost

USDW. No fractures were detected in the well bores and no transmissive faults or fractures are otherwise known to exist in the confining zone within the area of review. The confining zone will resist vertical migration because of its low natural permeability.

The confining zone must be separated from the lowermost USDW by at least one sequence of permeable and less permeable strata that will provide added layers of protection by either providing additional confinement (low permeability units) or allowing pressure bleed-off (high permeability units). Overlying the confining zone, the Clinton Formation is made up of shales and dolomite having low porosity and permeability. The Salina Formation contains thick beds of dense, plastic anhydrite and salt separated by dolomite, some of which is porous and permeable, and shale between 1,300 and 2,100 feet. The anhydrite and salt offer very effective barriers to fracturing and flow because they deform plastically under the weight of the overlying formations to reseal any void space. The White Niagaran between 2,133 and 2,227 feet is a dolomite which the well site geologist described as "a new disposal formation" in a letter mailed to the EPA on December 27, 2001. In addition, the Sylvania Sandstone between the depths of 400 and 550 feet is a thick, porous, and permeable formation which has been used extensively as an injection zone in the area. It is capable of accepting large amounts of fluid without developing hydrostatic pressures which would be high enough to either fracture it or even cause formation water to flow through an open conduit into the USDW. The layers are continuous for hundreds of square miles. They provide the added layers of protection required by the regulations.

4. <u>Geochemical Conditions</u> - The petitioner must adequately characterize the injection and confining zone fluids and rock types to determine the waste stream's compatibility with these zones. The injection zone is composed mainly of quartz sandstone, with minor amounts of siltstone and dolomite. These rock types are known to be resistant to most chemical attack. These Mt. Simon rock types are found in all wells which inject into the Mt. Simon. Periodic measurements in other wells injecting corrosive wastes into the Mt. Simon do not show changes in the size and shape of the well bores. Because these rocks generally are very resistant to chemical degradation, we anticipate little, if any, compatibility problems. To alleviate any problems that may arise from reactions between the native formation fluids and the injected wastes, EDS will inject fresh water to serve as a buffer between the formation water and the injectate before it begins to inject wastes and between injecting each batch of waste. The fresh water buffers will prevent wastes which might react with each other to form solids from mixing in the near well-bore region and will dilute the mixtures when they do come into contact as a result of mixing due to dispersion so that the possibility of reactions will be reduced. The confining zone is composed of silty shale and shaley dolomite. The injected fluid should have little effect on the dolomitic layers because dolomite does not react with dilute acids at the temperatures which will exist in the injection zone. The shale layers are very stable and will be essentially unaffected by contact with the injectate.

5. <u>Wells in Area of Review</u> - Under 40 C.F.R. §146.63, the area of review (AOR) of class I hazardous waste wells is a two-mile radius around the well bore or a larger area specified by EPA based on the calculated cone of endangering influence of the well. The cone of endangering influence is the area within which pressurizing the injection interval can raise a column of formation fluid or injected fluid sufficiently to cause contamination of a USDW. When calculated using values for geological parameters which are accepted as most likely to be representative of actual conditions, the cone of endangering influence for the EDS injection wells has a radius of 23,275 feet, or 4.4 miles from the center of the line between the two wells. However, because this did not represent a worst-case scenario, EDS used more conservative values and calculated an enlarged cone of endangering influence which reaches 32,280 feet from the center of the line connecting the two wells. Under 40 C.F.R. § 148.20(a)(2)(ii), a petitioner must locate, identify, and ascertain the condition of all wells within the injection well's area of review that penetrate the injection zone or the confining zone. EDS conducted a well search over the larger cone of endangering influence consistent with the requirements of 40 C.F.R. §§ 148.20(a)(2)(ii) and 146.64, and identified two wells penetrating the confining zone and/or injection zone. As discussed below both of these wells have been properly plugged, completed or abandoned so no corrective action is required under 40 C.F.R. §§ 148.20(a)(iii) and 146.64.

The McClure Oil Co. Fritsch et al. #1 is located about 4.5 miles south of the EDS site. That well was drilled to a depth of 2,885 feet in 1955 and then plugged with heavy mud with a bridge plug at 1750 feet. The plugging was approved on July 21, 1955, by the Michigan Department of Conservation. This well has been properly abandoned, and there is no potential for fluids to move through a conduit. Moreover, the maximum depth of this well is almost 800 feet above the reach of the predicted upward migration of waste from the EDS well.

The second well, the EDS #1-20, was drilled by EDS in 1993 at a site which was to be used for the facility under review. This well, which was properly completed pursuant to an EPA UIC permit, penetrates the entire injection zone. The lower portion of the well has been plugged using a cast iron bridge plug above the injection zone with 50 feet of cement on top of the bridge plug. This meets Region 5's standards for plugging wells within the AOR, and will prevent the well's casing from serving as a conduit for the movement of fluids from the injection zone. Moreover, on January 12, 1999, EDS entered into a Stipulation and Consent Agreement with the Michigan Department of Environmental Quality (MDEQ). This agreement authorizes EDS #1-20 to remain inactive and not be considered abandoned, so long as all applicable requirements are met, until 30 days after EDS' receipt of all MDEQ approvals for the Citrin Drive facility. The agreement requires EDS to permanently plug and abandon the well within that 30-day period. When the well is abandoned, the EPA UIC permit for well #1-20 requires that the well must be properly plugged and abandoned under a plan approved by EPA. Well # 1-20 is properly completed, is not abandoned, and will be permanently plugged and abandoned pursuant UIC requirements. Therefore, a corrective action plan under 40 C.F.R. §§ 148.20(a)(iii) and 146.64 is not required.

It is probable that Sun Pipe Line Company will drill at least one injection well slightly more than one half mile from the nearest EDS well. Region 5 issued a permit for the construction of a well to be used for the injection of non-hazardous salt brine about 2,800 feet northeast of the nearest EDS well. Any injection wells which the Sun Pipe Line Company drills will be constructed to standards approved by Region 5 for the protection of USDWs and the construction will be overseen by Region 5's contract inspectors.

Because no wells penetrating the confining zone or injection zone are improperly plugged, completed or abandoned, a corrective action plan is not required under 40 C.F.R. §§146.64 and 148.20(a)(2)(iii).

6. Absence of Known Transmissive Faults – There are no known transmissive faults in the Glenwood, Trempealeau, and Franconia Formations, the strata within the injection zone that will confine fluid movement. Moreover, the interference test conducted on June 12-15, 2002, indicates that there are no transmissive fractures cutting the injection interval within the area between and near the wells.

E. The Use of Predictive Models to Demonstrate No Migration - The most practical and credible means for petitioners to demonstrate no migration of hazardous constituents from the injection zone is through the use of predictive mathematical models.

1. Conceptual Models - As discussed in the preamble to the final rule for petitioning for exemption, no-migration demonstrations rely upon conservative modeling techniques to evaluate the potential for migration of hazardous constituents from the injection zone. Fluid flow modeling is a well-developed and mature science and has been used for many years in the petroleum industry. A wide range of models exists that provide the capability to analyze pressure build up, lateral waste migration, vertical fluid permeation into overlying confining material, and leakage through defects in overlying aquitards; and models make it possible to predict tendencies or trends of events that have not yet occurred or that may not be directly observable. Under the no migration standard, a demonstration need not show exactly what will occur, but rather what conditions will not occur. Conservative modeling can be used to "bound the problem" and can legitimately form the basis for the petition demonstration. (*See* 50 FR 28126 - 28127 (July 26, 1988)).

2. <u>Model Validation</u> - The conceptual model incorporated within the "no-migration" demonstration must be validated. The objective of model validation is to demonstrate that the model adequately represents the type of rock layers, the physical processes of the injection zone, and the boundary conditions of the modeled interval.

In this case, a two-layer model was found to match the pressure responses measured during an interference test. We know from the measurements made during drilling that there are many layers of significantly different properties within the injection zone. However, it is often the case that the effects of many layers can be consolidated so that a simpler model can be used. The values determined for the two model layers are reasonable based on the type of rock in the injection zone and the actual measurements of physical properties. As a result, this part of the model is validated.

3. Verification of Mathematical Simulators - When used to make predictions, the simulator must be adequately verified. The verification process has two principal objectives: (1) to ensure that the simulation code is mathematically accurate, and (2) to ensure that the various features of the code are used correctly. Frequently simulators are verified by comparing the results of the simulator to be verified against the results from a previously verified simulator or an analytical solution.

Several different computer programs were used to simulate various phenomena in this demonstration. Pressurization was simulated using a computer code named INTERACT. The movement of the plume was simulated using empirical formulas which were verified by matching results of simulations incorporating similar models against those produced by SWIFT II, which has been extensively verified. Each of these methods and computer codes has been used in previous no migration demonstrations.

F. Application of Computer Simulation to the No-migration Demonstration - The petitioner chose to demonstrate that waste injected at the EDS facility wastes will remain in the injection zone and will not migrate to a point of discharge or interface with an underground source of drinking water for a period of 10,000 years. This demonstration was based on a showing that a geological model representative of the disposal reservoir and the overlying rock strata would contain the waste constituents within the disposal reservoir for a period of 10,000 years under the conditions of the simulation.

1. **Model Development and Calibration** - The development of the EDS model was conceived to be conservative to account for the uncertainties which exist because of inherent geological variability and because the subject wells had not been constructed at the time the modeling was begun. A conceptual model was developed using information developed from logs, core and other testing carried out during drilling of the EDS #1-20 well. The model included hydrogeologic information such as porosity, permeability, and thickness of the various zones. Next, this initial set of hydrogeologic parameters was calibrated or fine-tuned by comparing pressure responses predicted using these parameters to pressure records from injection tests of wells #1-12 and 2-12 made during the period from June 12-15, 2002.

Other model parameters, such as viscosity of the injected fluid, and diffusion coefficients of the waste constituents, were assigned from site-specific information when possible, and otherwise based on values which have been reported in similar situations and appeared in peer-reviewed writings. Where parameters were uncertain, conservative values were chosen. For those parameters most affecting pressure build up and waste migration, such as permeability, a range of values was modeled so that pressure and migration under less favorable conditions could be determined. This sensitivity analysis indicated that containment of wastes within the injection zone would occur even if actual conditions are much less favorable than there is reason to suspect.

The original model assumed that flow within the injection zone would be within a single zone of uniform properties. This model failed to allow simulations of tests made in the #2-12 well to match pressures actually measured. EDS conducted an interference test by injecting water into one well and measuring the pressure in the other well to eliminate the pressure effects caused by residual blocking of pore throats in the sandstone reservoir adjacent to the well bores. Good data were obtained through this test, but the simulator could still not match the measured pressures. Other models were tried. A model incorporating layers having differing permeability with flow possible between the layers was found to result in a remarkably close match. The poorest match between correlative simulated and measured pressure values was within 1.5%. For the most part, the simulator was able to match the real data almost perfectly. The successful model includes one layer which is 33 feet thick with a permeability of 400 md and one which is 190 feet thick with a permeability of 63.43 md, as mentioned above in the Injection Zone Description. The porosity of both zones was set at 11%.

This two-layer model is a reasonable explanation of how the disposal reservoir which was investigated during the drilling of the three EDS wells will react to injection. The logs and cores showed that there are many individual layers with varying permeability and that their effective net thickness is in the range of 200 to 250 feet. The average net porosity of these layers is about 11%. Other values used in the simulation also match those measured or calculated using standard procedures.

As a result of approximating measurements made by tests in the wells, the model has been proved to be a valid surrogate for the reservoir itself. EDS actually modeled pressure buildup and plume movement only in the thinner zone (33 feet thick with 400 md permeability) to simplify the predictive modeling, This is conservative because it results in a more widespread plume and a larger radius for the zone of endangering influence than the use of the full two-layer model would. Although the results are less accurate than they might be, the deviation from accuracy is toward making the results appear to be "worse" than we have reason to expect. Because we are less interested in accuracy than in ensuring we made conservative assumptions, such simplifications are an acceptable and commonly used practice.

2. <u>Model Predictions</u> - Two simulation time periods were considered in the demonstration: a 20-year operational period and a 10,000-year post-operational period. For the operational period, vertical migration was calculated as though the maximum allowable pressure was used for injection through the entire operational period. For the post-operational period, additional lateral migration due to the natural flow gradient and buoyancy, and additional vertical migration due to molecular diffusion were simulated. Modeling results, and the parameter choices which ensure that these results represent reasonably conservative conditions, are presented below.

For the simulated operational period, the total simulated injection rate for the facility was set at 166 gpm for the first 19 years and 11 months of the 20-year service life. For the final month, the simulated rate was increased to 270 gpm for a single well.

This rate plan results in the highest possible pressurization of the reservoir. However, the 33-foot reservoir layer accepted half of this volume while the 190 feet of the well bore with lower permeability accepted the remainder. This flow split was determined through the simulation. The product of the thickness and the average permeability of a zone relative to other available zones determines the fraction of flow which it will accept. The pressure increase in the 33-foot zone is the only result which was calculated. Assuming injection at the maximum rate into a portion of the injection zone provides a conservative cushion to the demonstration by causing an over-prediction of waste migration. To simplify computation and make the assumptions more conservative, the increase of 1,176 psi, which was predicted to occur only at the end of the operational period as a result of increasing the injection rate to 270 gpm, was assumed to exist for the length of the entire operational period. The maximum pressure buildup will be greatest near the injection wells and will decrease outward, declining to less than 89.6 psi at a distance of 4.4 miles (the edge of the regulatory Area of Review) at the end of the twenty-year operational period.

Analytical solutions were also used to predict vertical waste migration. To be conservative, EDS doubled the length of the operational period, assumed that the maximum pressure will exist throughout this period, and found that injectate will penetrate through 10.1 feet of the arresting strata.

During the post-operational period, pressure in the injection zone will decrease and cease to cause movement. Molecular diffusion, which is random motion of individual molecules through the watery fluid which permeates even apparently dense rock, becomes the primary mechanism causing upward migration. EDS used an integrating method, taking into account lithologic differences for each foot of movement, to calculate vertical diffusion distance above the level reached by injectate during the operational period. This method also used the highest coefficient of molecular diffusion for any waste constituent and a concentration reduction to one trillionth (10^{-12}) of the starting concentration. This means that the resulting distance is that at which the concentration of any constituent will be less than one part in a trillion. For constituents which are still toxic at concentrations of one in a trillion, EPA will impose limits on starting concentrations in the injectate to ensure that no constituent will migrate beyond the resulting distance in hazardous concentrations. The EDS UIC permits will be modified to incorporate these limits. The maximum vertical movement of the waste front during the post-operational period is 227 feet from the assumed starting point at 3,925 feet upward to 3,698 feet, 239 feet below the top of the injection zone. This is a conservative estimate because it assumes 100% concentration of the most mobile constituent at the limit of pressure driven fluid movement for the entire post-operational period. Therefore, the waste will be contained within the vertical limits of the permitted injection zone throughout the post-operational period.

Lateral migration of the waste plume during the operational period is driven almost exclusively by injection pressure. If 100% displacement of formation waters from a cylinder of rock 33 feet thick with an effective porosity of 11% is assumed, the plume edge would be 3,199 feet from a single well at the end of the 20-year simulation period. This distance is further increased as a result of failure to displace 100% of native formation waters from the cylinder surrounding the wells. The effect of this failure and diversion of waste from straightline movement as a result of diversion around sand grains is called dispersion. The effects of dispersion can be calculated. The preparers of the EDS demonstration used a reasonably conservative estimate of 300 feet for longitudinal dispersivity and 25% of that value, 75 feet, for transverse dispersivity. Dispersion will increase the distance of flow by 13,607 feet in direction opposite the Sun wells. Therefore, at the end of the projected 20-year operational period, the total distance from the center of the plume to the southwest edge of the plume determined at the 10^{-12} concentration ratio (initial concentration/final concentration) is 16,806 feet. As mentioned in the Area of Review Section, it is possible that Sun Pipeline will be injecting 2000 gpm for about two years during the life of the EDS well at its Inkster Terminal one half mile to the northeast of the EDS facility. This injection would cause the center of the plume to be displaced 2,870 feet to the southwest, 141 degrees west of north. This would drive the southwest edge of the plume 6,069 feet from the center of EDS' injection. Dispersion would increase this to 16,806 feet. Therefore, the plume could extend more than three miles from the wells at the end of the projected 20-year operational period. This distance is within the area of review.

The simulation of plume-flow distance and direction during the post-operational period considered buoyancy and the natural flow within the Mt. Simon and Eau Claire Formations added to the movement which occurs during the operation of the wells. Buoyancy flow occurs because the strata into which waste will be injected dip slightly northwest into the Michigan Basin and the specific gravity of the injected waste will be different than that of the native water now filling the pores in the injection zone. Buoyancy resulting from either lighter waste being injected into a more dense native brine or a denser waste being injected into a less dense natural formation water results in a substantial movement of the waste front. Because of the conservative assumptions concerning the specific gravity of the injected waste, the amount of movement due to the effects of buoyancy is conservative.

The direction of buoyancy flow is 42 degrees west of north for a heavier waste and 166 degrees east of north for a lighter waste. EDS assumed that 100% of the waste to be injected will be a brine with a specific gravity of 1.22 (the heaviest fluid which might be injected) when calculating the distance of flow down into the Basin. When calculating the distance of movement up dip they assumed 100% of the waste will be methanol (the lightest fluid which might be injected) with a specific gravity of 0.88. Because the difference between the specific gravities of the native brine (1.153) and methanol is greater than the difference between those of a heavy waste, 1.22, and the native brine, the distance of movement due to buoyancy will be greater to the southeast. The angle of dip must also be considered. The dip to the southeast is 1.14 degrees and that to the northwest is about 0.68 degrees. To be conservative, the greater angle of dip was used to calculate the distances in both directions. The distance of updip movement of the centroid of the plume possible as a result of buoyancy is 14,792 feet in a direction 166 degrees east of north if the entire plume is as light as methanol.

Calculations based on the measurements made at the #2-12 well and several others indicated that the rate of flow is 0.4 ft/year in a northeasterly direction. The effect of regional flow could result in an additional 4,000 feet of drift plus associated dispersion to the movement of the waste plume over 10,000 years. Because the direction of flow is actually somewhat uncertain, the 4,000 feet of possible movement due to regional flow was added to the total distance of the movement regardless of which direction it was calculated. The net updip movement of the plume centroid is 20,672 feet in a direction 172 degrees east of north.

From that point, an analytical method was used to account for dispersive spread and project plume movement to the health-based limits. To make this calculation, the distance the center of the plume is displaced by regional flow (4,000 feet), the distance the center of the plume is displaced by buoyancy (14,792 feet), and the distance the center of the plume might be displaced by the proposed Sun injection (2,870 feet), each acting alone, are added, for a total distance of 21,662 feet. As explained earlier, the edge of the plume of hazardous waste is found where the concentration of waste constituents is reduced to one trillionth of the original concentration. Dispersion will move the health-based limit 27,539 feet beyond the end of the undispersed plume edge. At this distance, all hazardous constituents will be below the health-based levels or detection limits. To calculate the total distance of movement in the updip direction, the original radius of the plume (3,199 feet), the distances which the centroid is displaced by injection through other wells (2,870 feet), regional flow (4,000 feet), buoyancy (14,792 feet), and the distance added by dispersion must all be added, taking into account differences in the directions of the component vectors, including an additional 1,580 feet which SWIFT modeling indicates should be added to the results determined using the analytical method. Therefore, the maximum predicted lateral migration of waste at the EDS site is 52,990 feet (10 miles) in the updip, or southsoutheast, direction.

EDS used similar methods to calculate the distance of movement in various directions away from the injection wells. The downdip plume edge was found to be within 36,158 feet or 6.85 miles of the injection center in a northwesterly direction. The nearest point of discharge into a USDW is hundreds of miles to the west. Figure 2 shows the distances beyond which we can be very certain that the waste will not spread through a period of 10,000 years. Therefore, EDS has demonstrated to a reasonable degree of certainty that hazardous constituents will not migrate vertically out of the injection zone nor laterally to a point of discharge in a 10,000 year period.

G. **<u>Quality Assurance and Quality Control</u>** - EDS and its consultants have demonstrated that adequate quality assurance and quality control plans were followed in preparing the petition. EPA approved a quality assurance project plan on November 1, 2001. Some changes were made to accommodate changes in plans. These were reviewed and given informal approval as necessary. EDS followed an appropriate protocol for locating records for penetrations in the AOR, for collection and analyses of geologic and hydrogeologic data, for waste characterization, and for all tasks associated with the modeling demonstration.

III. Conditions of Petition Approval

In order to receive an exemption from the ban on injection of certain hazardous wastes, the EDS injection operation must meet the no-migration standard and the operation must be protective of human health and the environment. Federal regulations at 40 CFR §146.13(a) establish the standard for a safe injection pressure. Region 5 has determined that operation at or below fracture closure pressure is the best means of assuring that the facility's injection pressure will be protective of human health and the environment. Therefore, as a condition of granting this exemption from the ban on injection of certain hazardous wastes, the EPA will impose following conditions:

(1) The permitted injection zone must be comprised of the Precambrian, Mt. Simon and Eau Claire, Franconia-Dresbach, Trempealeau, and Glenwood Formations from 3,369 to 4,550 feet below the surface;

(2) Injection shall occur only into that part of the Fraconia-Dresbach, Eau Claire, Mt. Simon, and Precambrian Formations which is more than 3,900 feet below the surface and less than 4,550 feet, true vertical depths, below the surface;

(3) The volume of wastes injected in any month through both wells at the site must not exceed 7,275,780 gallons. This volume will be calculated each month;

(4) Maximum concentrations of chemical contaminants which are hazardous at less than one part in a trillion (1:1,000,000,000,000) shall have limits for maximum concentration at the well head set through the permits;

(5) The injection pressure at the well head shall be limited to fracture opening pressure at the casing shoe. The fracture opening pressure while injecting waste of the highest density to be allowed was determined to be 903 psi (gauge) at the well head by tests constructed during drilling of well #2-12.

(6) The petitioner shall fully comply with all requirements set forth in Underground Injection Control Permits #MI-163-1W-C007 and #MI-163-1W-C008 issued by the EPA.

(7) This exemption is only granted while the underlying assumptions are valid. For

instance, if the injection rate at the SPL facility exceeds 2000 gpm averaged over a period of a year, EDS must run a new simulation to evaluate the effect.

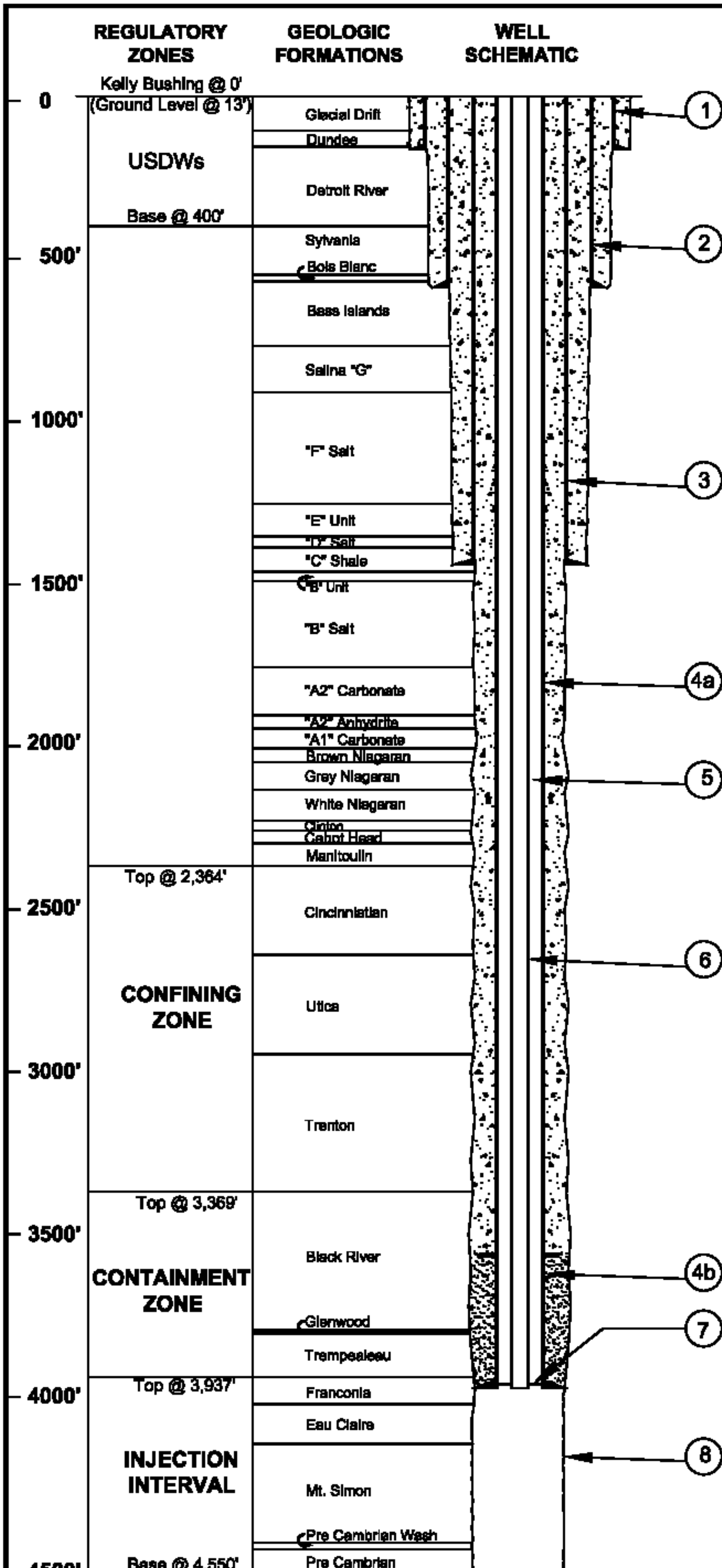
(8) The exemption will become invalid 20 years after injection commences. EDS must halt operations at that time unless Region 5 has approved a new, valid demonstration of no migration from the injection.

There are currently no extraction wells within the AOR, and the demonstration does not consider the effects of any extraction, such as the extraction of fluid from the Mt. Simon proposed by the SPL in the permit application denied by MDEQ. If SPL drills and operates one or more extraction wells in the AOR, then the conditions under which the EPA determined the no-migration demonstration to be valid would no longer exist and the Director will terminate the exemption. EDS would be prohibited from injection of hazardous wastes and authorization to inject nonhazardous wastes would probably be withdrawn. EDS would be allowed to resume injection only if a new demonstration, demonstrating compliance with the standards of 40 C.F.R. Part 148 Subpart C were approved.

Date:____

____

Jo Lynn Traub
Director, Water Division
Region 5, U.S. Environmental Protection Agency



BELOW GROUND DETAILS
(Depths = Measured Depths, Referenced to RKB)

1. **Conductor Casing**: 16 inch, 60 lb/ft casing set in a 20 inch hole at 169 feet and cemented to the surface with 300 sacks of Class A cement.

2. **Surface Casing**: 13 3/8 inch, 48 lb/ft, H-40 ST&C casing set in a 17½ inch hole at 598 feet and cemented to the surface with 350 sacks of 65/35 Pozzolan cement and 250 sacks of Class A cement.

3. **Intermediate Casing**: 9 5/8 inch, 36 lb/ft casing set in a 12¼ inch hole at 1,444 feet and cemented to the surface with 725 sacks of Class A cement.

4. **Protection Casing**: 7 inch casing set in an 8¾ inch hole at 3,983 feet and cemented to the surface in two stages as follows:
   a. **Stage I:** 5 joints of 7 inch, 20.42 lb/ft ST&C Hastelloy C-276 casing from 3,886 to 3,983 feet, with a 7 inch Halliburton Float Collar and Float Shoe connected to its base, and 7 joints of 7 inch, 26 lb/ft, K-55, LT&C carbon steel casing

from

3,565 to 3,886 feet; cemented in place with 686 gallons of

   b. Epseal epoxy cement mixed 12.5 lb/gal.
      Stage II: 7 inch, 26 lb/ft, K-55, LT&C from the surface to 3,563 feet with a 7 inch stage collar positioned from 3,563 to 3,565 feet; cemented in place with 650 sacks of 50/50 Standard Pozmix and 450 sacks of Standard cement.

5.

Annulus Fluid: 74 barrels of corrosion inhibited brine water.

6.

Injection Tubing: 132 standard joints of Tubular Fiberglass Company 4½ inch, Red Box 2000 fiberglass tubing and a set of pup joints (4, 8 and 10 feet), latched into the top of the injection packer at 3,965 feet with 14,000 lbs surface tension.

7.

Injection Packer: 4½ inch by 7 inch Model 12 Groundwater Protection Systems packer set at 3,965 feet.

8.

Open Hole Completion: 8¾ inch open hole from 3,983 to 4,550 feet.

SUBSURFACE

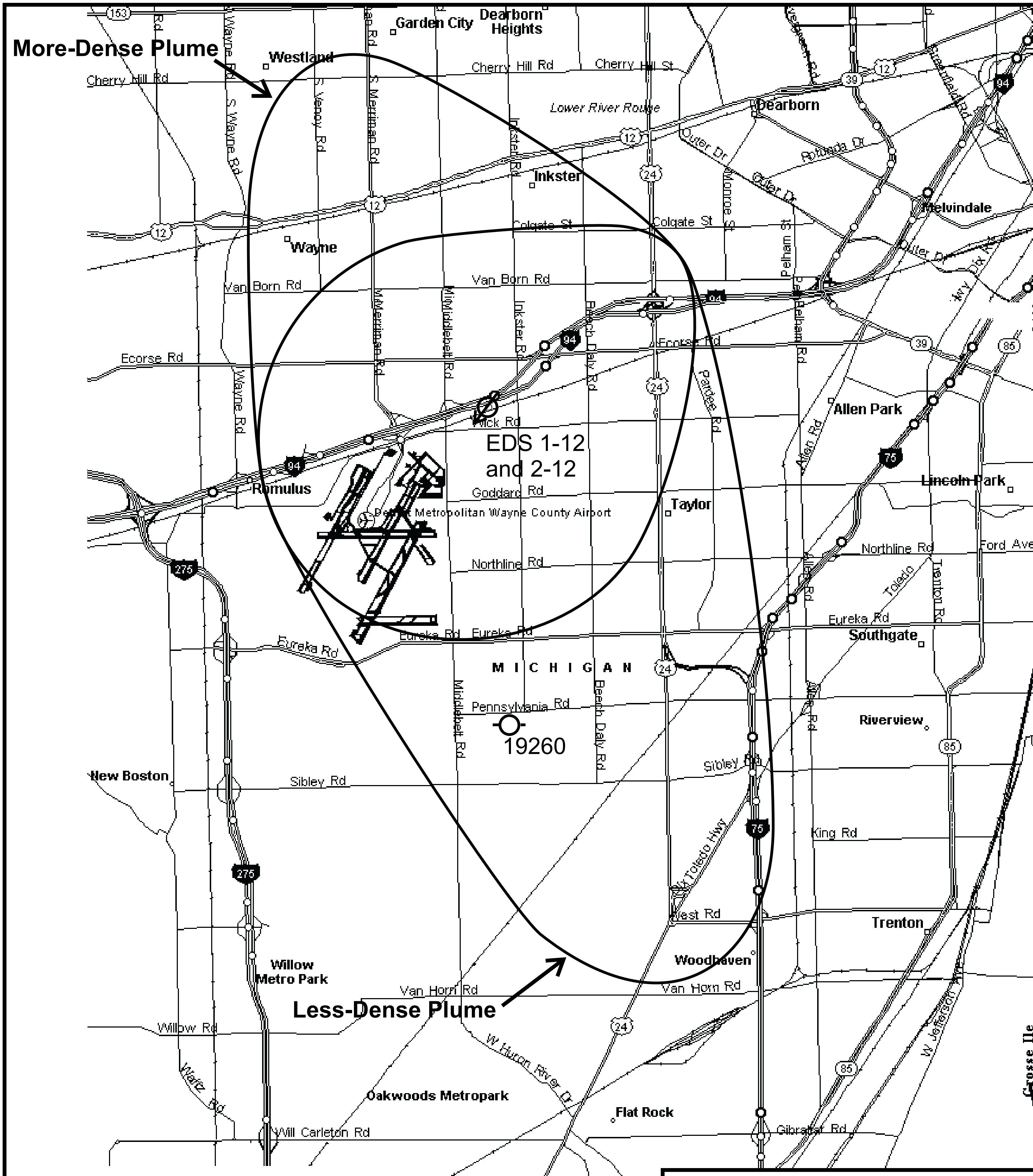
HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

FIGURE 1

ENVIRONMENTAL DISPOSAL SYSTEMS, INC.
ROMULUS, MICHIGAN

WELL SCHEMATIC
WELL 2-12

DATE: 08/16/02	CHECKED BY:	JOB NO: 60D5295
DRAWN BY: WDL	APPROVED BY:	DWG. NO:



Scale: 1 inch = 10,000 feet

Structure drawing from
Figure 10 of Petrotek, 1996

SUBSURFACE

Houston, TX
South Bend, IN
Baton Rouge, LA

FIGURE 2

ENVIRONMENTAL DISPOSAL SYSTEMS, INC.
ROMULUS, MICHIGAN

PLUME DIMENSIONS AND DISPLACEMENT

DATE: 08/23/02	CHECKED BY:	JOB NO. 60D5295
DRAWN BY: PWJ	APPROVED BY:	DWG. Number